Topic – Energy management and saving

Property adjustment of open-celled ceramic foams for high temperature applications assisted by numerical modelling

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Enhanced requirements in energy conversion processes as well as chemical engineering, relating to thermal efficiency, durability and thermal limitation of use, necessitate an application related design of materials and components. Open-celled ceramic foams offer a unique scope of adjustable properties and are therefore of particular interest, for example in combustion and heat conversion processes, such as concentrated solar power (CSP). Based on intensive studies, a lot of different CFD models have been published recently for the prediction of foam properties. Combining those models, with experience in the design of receiver structures and the preparation of ceramic foams, one aim of the CAPTure (Competitive SolAir Power Towers) project, funded by the European Union, is the development of receiver foam structures with higher efficiency and durability.

The presentation will be focused on ceramic foams made of the high temperature stable, pressure less sintered Silicon Carbide. Besides, the material itself and its intrinsic features like graduated density, the structural parameters characterizing the foam, such as cell size, strut shape and the herewith connected porosity, can be used for a foam design adapted to the application. The challenge is to find an optimal compromise between very thin struts for the highest radiative efficiency and a high mechanical and oxidation stability at once. However, some limiting parameters remain and therefore the property prediction of the foams entails the experimental validation of the simulated behavior.

Different approaches for designing foams for high temperature applications will be presented including the material selection, the preparation parameters and the characterization. Instancing ceramic foams as receiver material for CSP, the strong interconnection between the structural and functional design will be pointed out. In addition, the potential of surface modification by subsequent coatings steps via dip or spray coating will be addressed and first results of the evaluation of their influence on the optical properties will be presented.